REMARKS

Claims 1 to 10 are all the claims pending in the application, prior to the present Amendment.

Claims 2, 6, 9 and 10 have been rejected under the second paragraph of 35 U.S.C. § 112 as indefinite.

The Examiner sets forth two reasons for this objection. Applicant discusses each reason below.

With respect to claim 2, the Examiner states that it is unclear what is meant by the term "as measured within a range of a temperature of the melt to 800°C." The Examiner does not provide any reason as to why he believes this term is not clear.

Applicant first notes that the recitations of claim 2 relating to the temperature of the melting have been incorporated into claim 1. Further, applicant has amended claim 1 to recite the cooling rate for the quenching. Thus, claim 1 now recites the step of "rapidly quenching the melt at a cooling rate of 5×10^2 to 3×10^3°C/second, as measured within a range of the temperature of the melt to 800°C." Support for the cooling rate can be found at page 9, lines 21-22 of the present specification. In view of this amendment to claim 1, applicant has canceled claims 2, 9 and 10.

The "range" that is referred to in claim 1 is the temperature range at which the cooling rate in claim 1 occurs. The temperature of the melt is the temperature of the melt obtained during the melting, and the temperature range at which the recited cooling rate occurs is defined by this temperature and 800°C.

Applicant submits that one of ordinary skill in the art would understand the meaning of claim 1 as amended above.

With respect to claim 6, the Examiner states that the phrase "and further contains a phase, other than the filled scutterudite phase, having a maximum diameter of 10 μm or less" is unclear.

The Examiner states that he has interpreted this phrase to refer to the maximum grain diameter.

In response, applicant advises the Examiner that he has correctly interpreted claim 6. Applicant has amended claim 6 by inserting the word "grain."

In view of the above, applicant submits that the claims comply with the requirements of the second paragraph of 35 U.S.C. § 112 and, accordingly, requests withdrawal of this rejection.

Claims 1, 5, 6, and 8 have been rejected under 35 U.S.C. § 102(b) as anticipated by the cited Kitagawa et al article.

In addition, claims 2, 4, 9 and 10 have been rejected under 35 U.S.C. § 103(a) as obvious over Kitagawa et al and further in view of EP 1 030 317 to Hirota et al and the Lange Handbook.

As discussed above, applicant has canceled claims 2, 9 and 10, thus leaving claims 1, 4-6 and 8 as being subject to this rejection.

Applicant submits that Kitagawa et al do not disclose or render obvious the subject matter of claims 1, 4-6 and 8 and, accordingly, requests withdrawal of this rejection.

The present invention as set forth in claim 1 as amended above is directed to a method for producing a filled skutterudite-based alloy, comprising melting alloy raw material comprising a

rare earth metal R that is at least one species selected from among La, Ce, Pr, Nd, Sm, Eu and Yb, a transition metal T that is at least one species selected from among Fe, Co, Ni, Os, Ru, Pd, Pt and Ag, and metallic antimony Sb at a temperature of 800 to 1,800°C to form a melt, and rapidly quenching the melt at a cooling rate of 5×10^2 to 3×10^3°C/second, as measured within a range of the temperature of the melt to 800°C through strip casting to form a solidified product.

The Kitagawa et al article does not disclose or suggest a "strip-casting" method as set forth in claim 1.

Kitagawa et al disclose a "spin-cast" method for making ribbons. In the Office Action, the Examiner asserts that the spin-cast method of Kitagawa et al is the same as the strip-casting method of the present invention. However, the strip casting method of the present invention is different from the spin-cast method disclosed by Kitagawa et al.

The spin-cast method, as its name suggests, is a method which includes pouring a string-like melt onto a roller rotating at high speed and rapidly quenching this string-like melt on the roller. However, when the spin-cast method is employed, a technical problem is caused. Namely, a filled skutterudite thermoelectric conversion element having a satisfactory purity is difficult to obtain since the produced alloy ribbons assume an amorphous condition or contain decomposition products. Further, the alloy ribbons must be heated at 873 K to 1,073 K for five hours or longer so as to attain a practically usable purity, thereby causing another problem. See page 4, lines 18-30 of the present specification.

In contrast, a strip casting method is a method which includes pouring a belt-like melt onto a rotating roller and rapidly quenching this belt-like melt on the roller. There is the

technical feature that the strip casting method has a lower solidification rate than the spin-cast method.

The spin-cast method disclosed by Kitagawa et al requires the condition of operating a copper roll at a peripheral speed of 10 m/s so as to make the melt solidify into the shape of ribbons with a thickness of 20 μm. See the discussion under the heading "2. Experimental" in the left column at page 334 of Kitagawa et al.

In contrast, through the strip casting method, the molten alloy can solidify into alloy strips having a thickness of 0.1 mm to 2.0 mm (corresponding to 100 μm to 2000 μm), as disclosed at page 10, lines 9-15 of the present specification. For example, as illustrated in Example 1 of the present specification, the molten alloy can solidify into alloy strips having a thickness of 0.28 mm (280 μm) when the copper roller is rotating at a rotating speed of 0.92 m/s. See page 13, lines 9-20 of the present specification.

In other words, this means the spin-cast method requires a peripheral speed of the roll that can be more than ten times the peripheral speed of the roll in the strip casting method, and that the thickness of the rapidly-solidified alloy produced by the spin-cast method can be less than one fifth of the one produced by the strip casting method.

With respect to the cooling rate, the Examiner acknowledges that Kitagawa et al do not do not teach a cooling rate of 10^2 to 10^4°C/second, but relies on Paragraph [0027] of Hirota et al, which discloses a cooling rate of 5,000 to 9,000°C/second. This cooling rate, however, is not within the 5×10^2 to 3×10^3°C/second cooling rate recited in claim 1 as amended above.

Accordingly, applicant submits that the combination of Kitagawa et al, the Lange Handbook and Hirota et al would not have led one of ordinary skill in the art to the present invention.

Further, Kitagawa et al discloses that the solidified alloy in the shape of ribbons is annealed at 973K x 36 ks (10 hours) or 773K x 36 ks. On the other hand, the filled skutterudite phase content in the produced alloy strips in Example 1 of the present is reported to be 98% or more, as disclosed at page 13, lines 21-27 of the present specification. Accordingly, this filled skutterudite phase is advantageously usable without heat treatment.

As can be seen from the above, Kitagawa et al do not disclose or suggest the subject matter of the present invention as set forth in claim 1.

With respect to claim 4, the Examiner acknowledges that Kitagawa et al do not disclose a thickness of 0.1 to 2.0 mm. The Examiner argues that it would have been obvious to select an appropriate thickness/size.

A thickness of 0.1 mm is about 5 times larger than the 20 μm thickness disclosed in Kitagawa et al. The Examiner has not provided any reason why such a thickness would be considered "appropriate" in Kitagawa et al. Accordingly, applicant submits that the rejection of claim 4 is based on hindsight.

In view of the above, applicant submits that Kitagawa et al do not disclose or render obvious the subject matter of claim 1, and the claims dependent thereon, and, accordingly, requests withdrawal of these rejections.

Claims 3 and 7 have been rejected under 35 U.S.C. § 103(a) as obvious over Kitagawa et al.

Applicant submits that Kitagawa et al do not disclose or render obvious the subject matter of claims 3 and 7 and, accordingly, requests withdrawal of this rejection.

Claims 3 and 7 depend from claim 1. Accordingly, applicant submits that these claims are patentable over Kitagawa et al for the same reasons as discussed above.

In addition, applicant submits that claims 3 and 7 provide a further basis for patentability.

With respect to claim 3, the Examiner acknowledges that Kitagawa et al do not disclose the specific atmospheric pressure.

The Examiner states that Kitagawa et al disclose an argon atmosphere. The Examiner argues that it would have been obvious to one of ordinary skill in the art to melt the alloy raw material in an argon inert gas atmosphere at a pressure higher than 0.1 MPa, and not higher than 0.2 MPa, because adjusting the argon pressure, as necessary, would minimize defects in the metal ribbons, and would have been within the skill of the art.

Applicant submits that the Examiner's rejection of claim 3 is based on hindsight because there is no teaching or suggestion in Kitagawa et al that the argon pressure would minimize defects.

Further, when the alloy raw material is being melted by heat, this raw material is generally dissolved at a pressure lower than atmospheric pressure because there are dangers that the temperature and the pressure of the melt of the alloy raw material rise very rapidly. Accordingly, applicant submits that it was not obvious for a person of ordinary skill in the art to melt the alloy raw material at the pressure higher than atmospheric pressure of 0.1 MPa.

Turning now to claim 7, the Examiner recognizes that Kitagawa et al do not disclose the oxygen, nitrogen and carbon content in a total amount of 0.2 mass% or less. The Examiner argues that since Kitagawa et al discloses examples in which the metal ribbon is comprised of 100% $LaFe_4Sb_{12}$, it would have been obvious to expect that the content of oxygen, nitrogen and carbon would be present in a total amount of 0.2 mass% or less.

Kitagawa et al disclose a metal ribbon comprised of 100% $LaFe_4Sb_{12}$ in Figure 5. However, the percentage compositions of all examples disclosed in Kitagawa et al were calculated on the basis of the measured X-ray diffraction patterns of the $(FeSb_3)_{1-x}$ La_x ribbons shown in Figure 1, and it is assumed that the composition of $LaFe_4Sb_{12}$ + $FeSb_2$ + Sb + La_2Sb + LaSb + $LaSb_2$ + FeSb is equal to 100%. See the discussion in Kitagawa et al under the heading "3. Results and Discussion," at page 335. The percentage composition of $LaFe_4Sb_{12}$ in Figure 5 of Kitagawa et al is calculated to be 100 %, without taking account of the existence of elements other than La, Fe and Sb.

Therefore, the percentage compositions of all examples disclosed in Kitagawa et al were not considered in view of the elements such as oxygen, nitrogen and carbon. Accordingly, applicant submits that Kitagawa et al do not suggest the subject matter of claim 7.

In view of the above, applicants submits that claims 3 and 7 are patentable over Kitagawa et al and, accordingly, requests withdrawal of this rejection.

Claims 1-10 have been provisionally rejected on the ground of non-statutory obviousness-type double patenting as unpatentable over claims 1-22 of copending Appln. No. 10/531,480.

Applicant requests withdrawal of this rejection in view of the submission of the Terminal Disclaimer.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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